

Die Welt vernetzen mit Broadcom Ethernet Adaptern

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Agenda

- Company Overview
- Ethernet Technology Trends
- Broadcom Ethernet Products
- Broadcom Storage Strategy
- Q & A

Company Overview



Safe Harbor Statement

This presentation contains forward-looking statements (including within the meaning of Section 21E of the United States Securities Exchange Act of 1934, as amended, and Section 27A of the United States Securities Act of 1933, as amended) concerning Broadcom. These statements include, but are not limited to, statements that address our expected future business and financial performance and other statements identified by words such as “will,” “expect,” “believe,” “anticipate,” “estimate,” “should,” “intend,” “plan,” “potential,” “predict,” “project,” “aim,” and similar words, phrases or expressions. These forward-looking statements are based on current expectations and beliefs of the management of Broadcom, as well as assumptions made by, and information currently available to, such management, current market trends and market conditions and involve risks and uncertainties, many of which are outside the Company’s and management’s control, and which may cause actual results to differ materially from those contained in forward-looking statements. Accordingly, you should not place undue reliance on such statements.

Particular uncertainties that could materially affect future results include risks associated with: the COVID-19 pandemic, which has disrupted, and will likely continue to disrupt, normal business activity, and which may have an adverse effect on our results of operations; any loss of our significant customers and fluctuations in the timing and volume of significant customer demand; our dependence on contract manufacturing and outsourced supply chain; our dependency on a limited number of suppliers; government regulations and administrative proceedings, trade restrictions and trade tensions; global economic conditions and concerns; cyclicity in the semiconductor industry or in our target markets; global political and economic conditions; our significant indebtedness and the need to generate sufficient cash flows to service and repay such debt; the amount and frequency of our share repurchase program; dependence on and risks associated with distributors of our products; dependence on senior management and our ability to attract and retain qualified personnel; any acquisitions we may make, such as delays, challenges and expenses associated with receiving governmental and regulatory approvals and satisfying other closing conditions, and with integrating acquired companies with our existing businesses and our ability to achieve the benefits, growth prospects and synergies expected by such acquisitions; involvement in legal proceedings; quarterly and annual fluctuations in operating results; our ability to accurately estimate customers' demand and adjust our manufacturing and supply chain accordingly; our competitive performance and ability to continue achieving design wins with our customers, as well as the timing of any design wins; prolonged disruptions of our or our contract manufacturers' manufacturing facilities, warehouses or other significant operations; our ability to improve our manufacturing efficiency and quality; our dependence on outsourced service providers for certain key business services and their ability to execute to our requirements; our ability to maintain or improve gross margin; our ability to protect our intellectual property and the unpredictability of any associated litigation expenses; compatibility of our software products with operating environments, platforms or third-party products; our ability to enter into satisfactory software license agreements; availability of third party software used in our products; use of open source code sources in our products; any expenses or reputational damage associated with resolving customer product warranty and indemnification claims; market acceptance of the end products into which our products are designed; our ability to sell to new types of customers and to keep pace with technological advances; compliance with privacy and data security laws; our ability to protect against a breach of security systems; fluctuations in foreign exchange rates; our provisions for income taxes and overall cash tax costs, legislation that may impact our overall cash tax costs and our ability to maintain tax concessions in certain jurisdictions; and other events and trends on a national, regional and global scale, including those of a political, economic, business, competitive and regulatory nature. Many of the foregoing risks and uncertainties are, and will be, exacerbated by the COVID-19 pandemic and any worsening of the global business and economic environment as a result.

Our filings with the SEC, which you may obtain for free at the SEC’s website at <https://www.sec.gov>, discuss some of the important risk factors that may affect our business, results of operations and financial condition. Actual results may vary from the estimates provided. We undertake no intent or obligation to publicly update or revise any of the estimates and other forward-looking statements made in this presentation, whether as a result of new information, future events or otherwise, except as required by law.

Broadcom at a Glance



FY21 net revenue of **\$27.5B**



\$4.9B investment in R&D in FY21

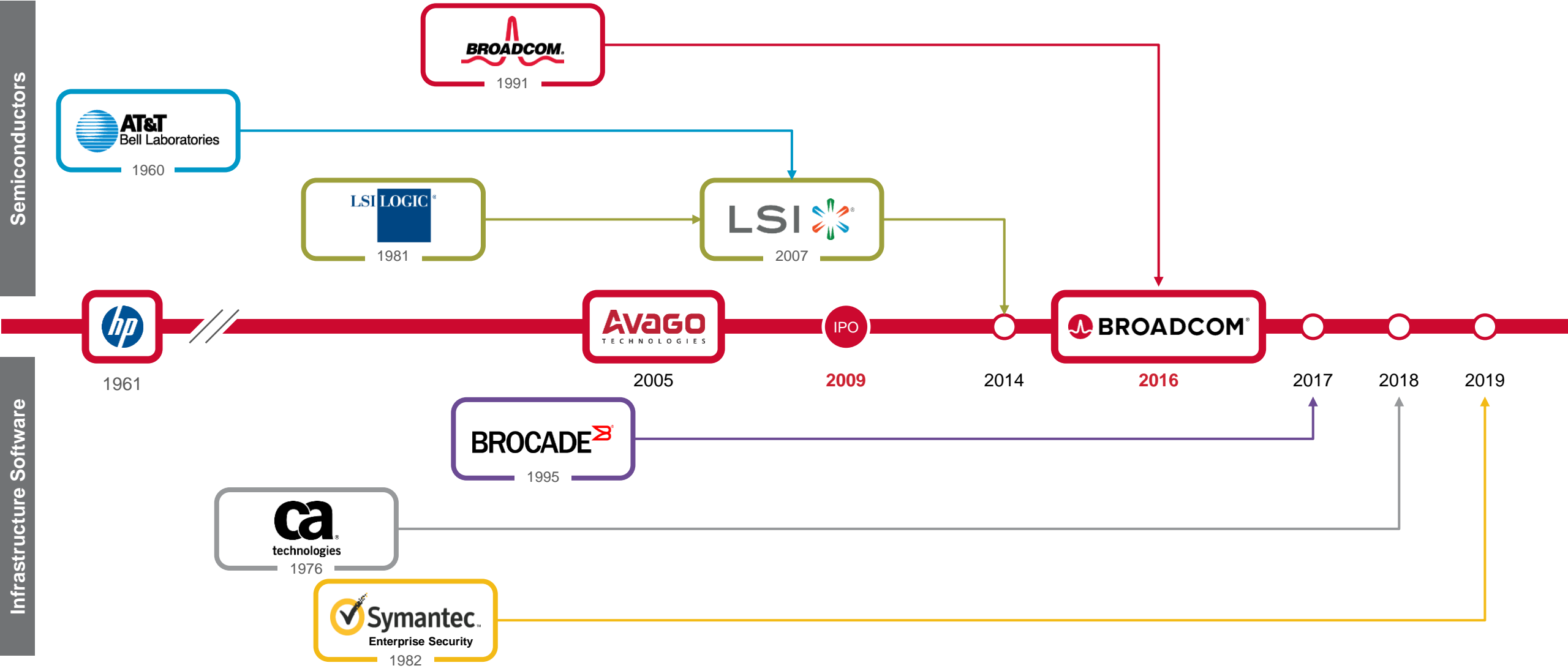


One of the industry's broadest IP portfolios with **>19,000** patents in FY21



22 Category-Leading Semiconductor and Infrastructure Software Divisions

Heritage of Innovation



Networking: High-Performance Connectivity

Enterprise



Service Provider



Hyperscale Data Center



Switching



Routing



Physical Layer



Optical Interconnect

Server/Storage Connectivity: On-Premises and Cloud

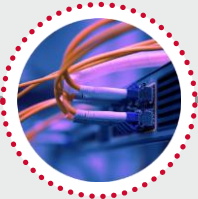
Enterprise



Hyperscale Data Center



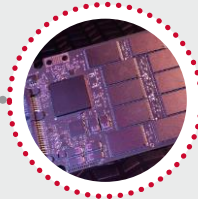
Fibre Channel HBAs



Fibre Channel SAN Fabric



RAID Adapters



SSD/HDD Controllers / Preamp



Ethernet NIC

Ethernet Technology Trends



PCI Technology Trends

Interface		PCIe 1.0	PCIe 2.0	PCIe 3.0	PCIe 4.0	PCIe 5.0	PCIe 6.0	PCIe 7.0
Date of Release		2003	2007	2010	2017	2019	2021	2025(planned)
Transfer rate		2.5 GT/s	5 GT/s	8 GT/s	16 GT/s	32 GT/s	64 GT/s	128 GT/s
Bandwidth	x1	250 MB/s	500 MB/s	0.99 GB/s	1.97 GB/s	3.9 GB/s	7.5 GB/s	15.1 GB/s
	x8	2 GB/s	4 GB/s	7.88 GB/s	15.75 GB/s	31.5 GB/s	60.5 GB/s	121 GB/s
	x16	4 GB/s	8 GB/s	15.75 GB/s	31.5 GB/s	63 GB/s	121 GB/s	242 GB/s
Encoding	NRZ						PAM-4 FEC	
	8b/10b			128b/130b			242b/256b FLIT	
Error Correction	8b/10b			no correction			CRC+FEC	

CRC - Cyclic Redundancy Check

FEC - Forward Error Correction

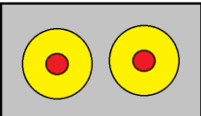
FLIC - Flow Control Unit (a 256B FLIT carries 242B of data)

Ethernet Technology Trends

Modulations

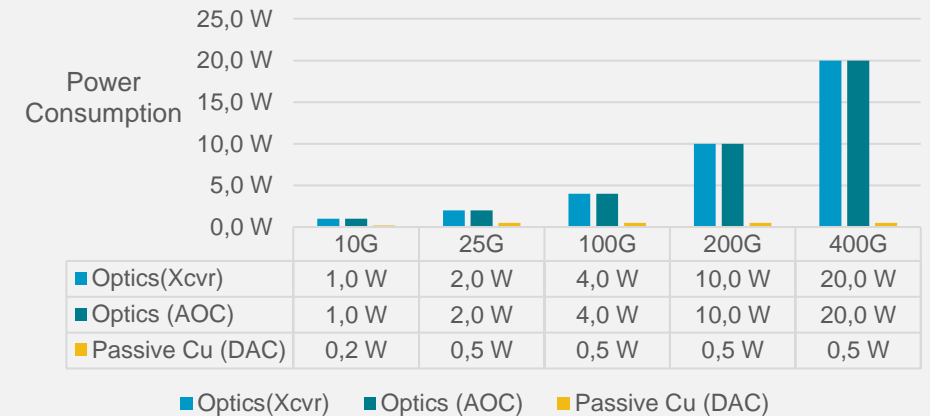
Technology	Speed	Features
NRZ	10G, 25G	None-Return-to-Zero
PAM4	50G,100G	Pulse Amplitude Modulation (PAM4 will also be used in PCIe gen 6)

Transceiver Technology

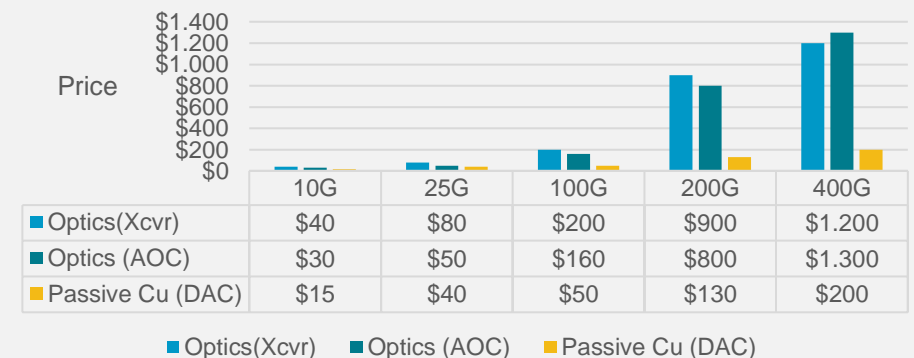
Technology	Speed	Features	Modulation
SFP+, SFP28	10G, 25G	SFP28 backwards compatible to SFP+	NRZ
QSFP+, QSFP28	10G, 25G	4x 10G, 4x 25G, QSFP28 backwards compatible to QSFP+	NRZ
SFP56, QSFP56	Up to 50G per port	Single, quad port, backward compatible to SFP28/QSFP28	PAM4/NRZ
SFP-DD, QSFP-DD	Up to 50G per port	Dual/Octal(8) port, SFP28/QSFP28 should work	PAM4/NRZ
DSFP 	up to 50G per port	Dual port, backwards compatible to SFP28	PAM4/NRZ
OSFP	Up to 100G per port	Octal(8) port not compatible to QSFP-DD, compatible via adapter with QSFP28	PAM4/NRZ
Pluggable Interconnects	Up to 100G per port	Internal Fibre to module or chip	PAM4/NRZ

Optics and Copper Trends

Power Consumption Optics/Copper cables



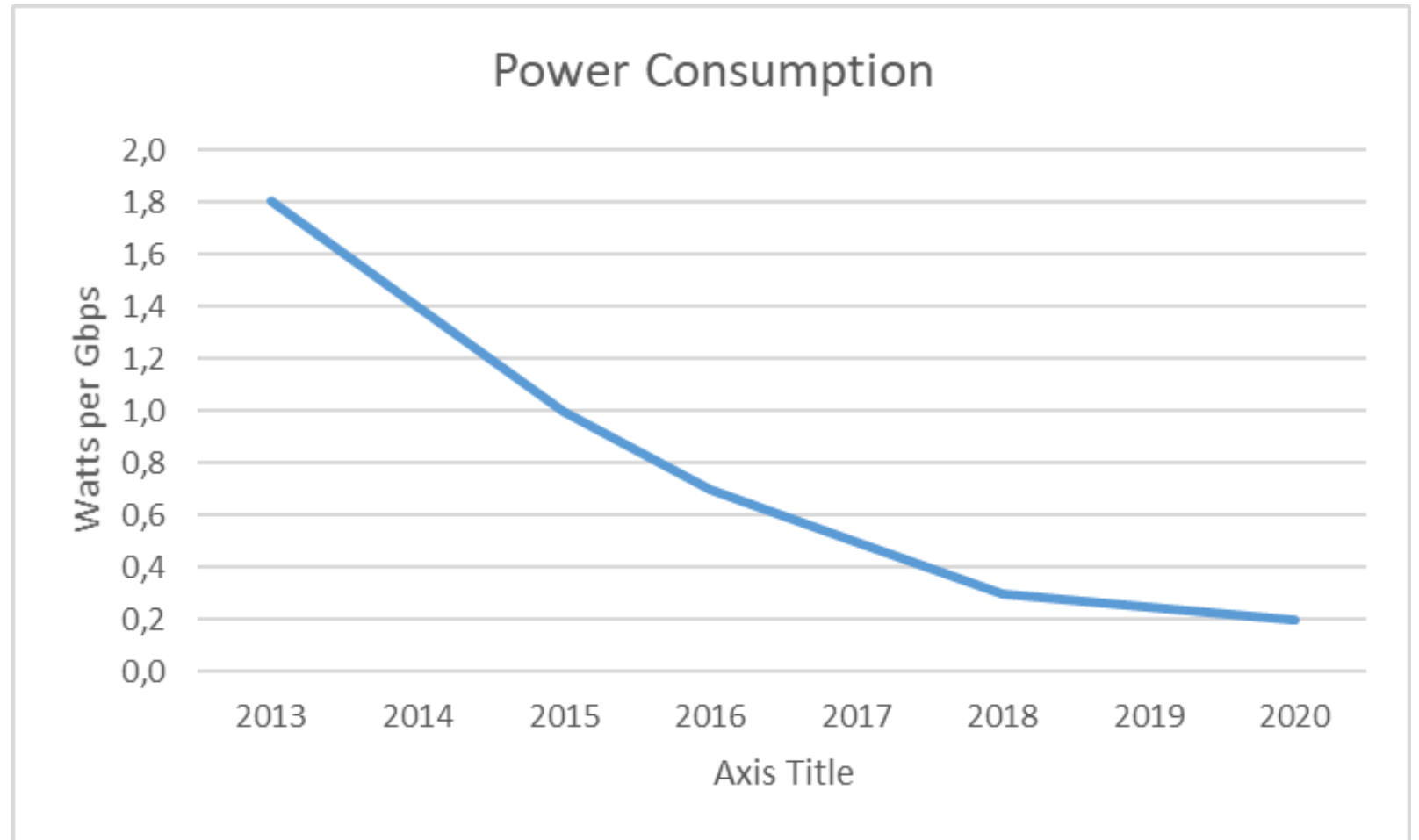
Price Optics/Copper cables



High-speed optics → Expensive and high-power

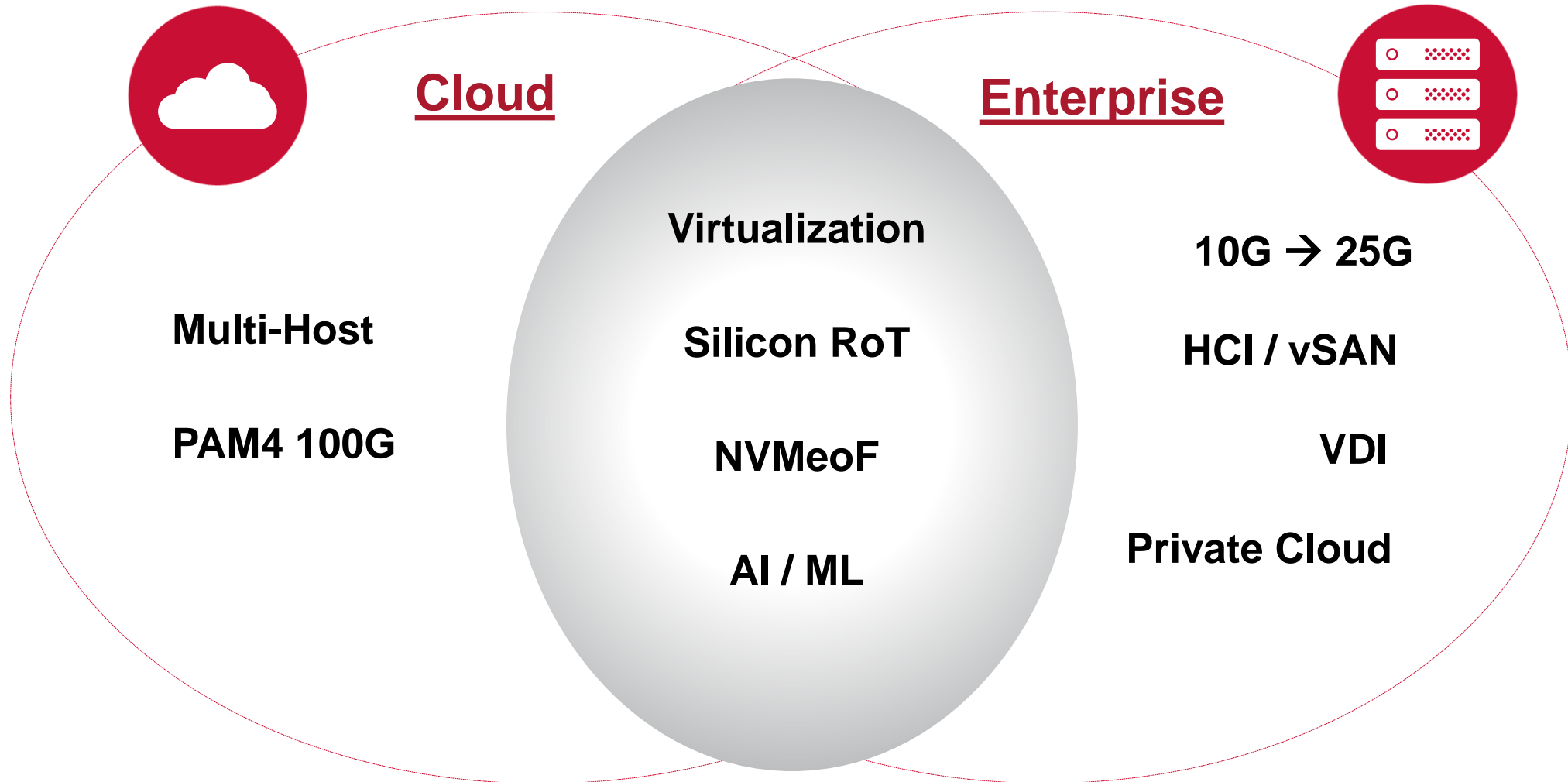
Transceiver Power Consumption

Form Factor	Power Consumption
10G SR	<1W
10G LR	<2W
25G SR	<1W
25G LR	<2.2W
100G SR	<2W
100G LR	<4.5W
100G SR (PAM4)	<3.5W
100G LR (PAM4)	<5W



Power Consumption varies a lot with type

Major Trends Impacting Ethernet in the Data Center



Server – TOR Networking Trends

25G → 100G → 200G → 400G	Driven by AI/ML
28G Serdes → 56G / 112G	Enables higher network speeds
Optics cost and power growing	Innovation : Silicon photonics, co-packaged optics, etc Thermal challenges Return to copper
RoCE	Driven by AI / ML
Telemetry	End-to-end, whole-network optimization

Growing technology dependencies between NIC and Switch

Networking Trends

- Multi-Host via OCP3.0 NICs
- PAM4 100G and higher (100G->200G->400G) driven by AI/ML
28G Serdes -> 56G / 112G
- Return to copper due to higher cost and power consumption of optics
- Telemetry – End-to-End, whole network optimization
- Virtualization
- Silicon RoT
- NVMeoF (RoCE)
- AI/ML
- HCI/vSAN/S2D
- VDI
- Private Cloud
- SD-WAN/VPN
- Automating Networks/Network-virtualization

Growing technology dependencies between NIC and Switch



Broadcom Ethernet Products



NetXtreme® Portfolio for Datacenter Networks

Core



100 GE → 400 GE

Spine



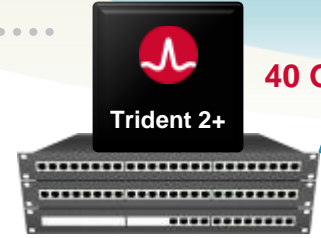
100 GE



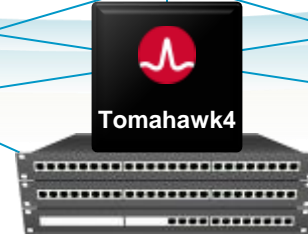
100 GE



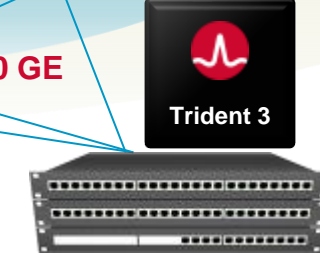
ToR



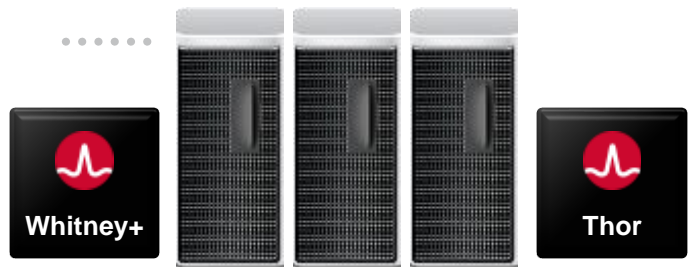
40 GE → 100 GE



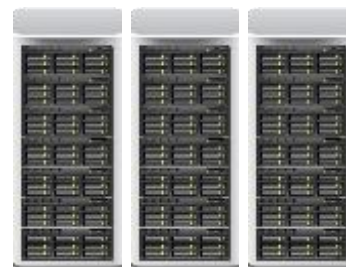
100 GE



NIC



Compute Cluster
10 GE → 25, 50 GE, Multihost



Storage Cluster
40 GE → 50, 100 GE



Machine Learning Cluster
25/50/100 GE



Broadcom/FOIT
Optical Interconnect



QSFP28 (4x25G)

- SR4 MMF
- CWDM4 SMF
- AOC
- DAC

SFP28 (1x25G)

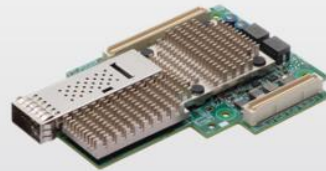
- SR MMF
- LR SMF
- AOC
- DAC

Broadcom Ethernet NIC Portfolio

Controllers



Adapters



OCP 2.0



OCP 3.0



OEM Mezz



PCIe NIC

Markets



Cloud



Enterprise



Telco SP



Embedded



Machine Learning



Storage

20+ years of proven software leadership: Consistent and Simplified
Features, management, security, performance

Broadcom Ethernet Controller Roadmap

NIC Bandwidth	1 / 2 / 4G	10 / 25 / 50G	200G
Family	NX1	Whitney+	Thor1
Product	5719 / 5720	57410	57500
Ethernet ports	4 / 2	2	4
1GBASE-T / 10GBASE-T	✓	✓	-
Primary Link-Speeds	1G (x4 / x2)	2x 25G 2x 10GBASE-T	4x 50G 2x 100G, 2x 200G
Network Serdes	1G	25G NRZ	56G PAM4
PCIe Host Interface	Gen2	Gen3 x8	Gen4 x16
Adapter Power - W (Typ / Max)	3 / 4	10 / 11	15 / 17
Min cooling @55C (LFM)	n/a	100	215
Multi-Host			1, 2 or 4 hosts
NPAR	-	NPAR1.1	NPAR1.2
RoCE v2		Gen1	Gen2
Silicon Root of Trust		✓	✓
Attestation			✓
IEEE1588 PTP	-	T-TSC	T-TSC / T-BC / T-GM
TLS / kTLS HW offload			



NetXtreme Ethernet PCIe NIC Portfolio

Form Factor	Marketing Name	Ports	I/O	ASIC	IC Family	Sampling	GA	Part Number
PCIe NIC	BCM5719-4P	4x 1GbE	RJ45	BCM5719	NX1	Yes	Yes	BCM95719A1904AC
PCIe NIC	BCM5720-2P	2x 1GbE	RJ45	BCM5720	NX1	Yes	Yes	BCM95720A2003AC
PCIe NIC	P210TP	2x 10GBASE-T	RJ45	BCM57416	Wh+	Yes	Yes	BCM957416A4160C
PCIe NIC	P210P	2x 10GbE	SFP+	BCM57412	Wh+	Yes	Yes	BCM957412A4120AC
PCIe NIC	P225P	2x 25/10G	SFP28	BCM57414	Wh+	Yes	Yes	BCM957414A4142CC
PCIe NIC	P425G	4x 25G	SFP28	BCM57504	Thor	Yes	Yes	BCM957504-P425G
PCIe NIC	P150P	1x 50GbE	QSFP28	BCM57414	Wh+	Yes	Yes	BCM957414A4140C
PCIe NIC	P2100G	2x 100G	QSFP56	BCM57508	Thor	Yes	Yes	BCM957508-P2100G

Broadest Portfolio of PCIe NIC Adapters: 1G to 200G

NetXtreme Ethernet OCP3.0 Portfolio

Marketing Name Suffix

GD	DSFP with Pull Tab bracket
G	SFP / QSFP and Pull Tab bracket
GI	SFP / QSFP and Internal Lock bracket

Form Factor	Marketing Name	Ports	I/O	ASIC	IC Family	Multihost / Multitroot	Sampling	GA	Part Number
OCP 3.0	N41GBT	4x 1G	RJ45	BCM5719	NX1	No	Yes	Yes	BCM95719N1905C/CI
OCP 3.0	N210tp	2x 10GBT	RJ45	BCM57416	Wh+	No	Yes	Yes	BCM957416N4160C/CI
OCP 3.0	N210p	2x 10G	SFP+	BCM57412	Wh+	No	Yes	Yes	BCM957412N4120C/CI
OCP 3.0	N225p	2x 25G	SFP28	BCM57414	Wh+	No	Yes	Yes	BCM957414N4140C
OCP 3.0	N425G	4x 25G	SFP28	BCM57504	Thor	MH	Yes	Yes	BCM957504-N425G
OCP 3.0	N1100G/GI	1x 100G	QSFP56	BCM57504	Thor	MH	Yes	Yes	BCM957504-N1100G/GI
OCP 3.0	N2100G/GI	2x 100G	QSFP56	BCM57508	Thor	MH	Yes	Yes	BCM957508-N2100G/GI

Broadest Portfolio of OCP NIC 3.0 Adapters: 1G to 200G

NetXtreme Ethernet OCP2.0 Portfolio

Form Factor	Marketing Name	Ports	I/O	ASIC	IC Family	Sampling	GA	Part Number
OCP 2.0	M210tp	2x 10GBASE-T	RJ45	BCM57416	Wh+	Yes	Yes	BCM957416M4163C
OCP 2.0	M210p	2 x 10GbE	SFP+	BCM57412	Wh+	Yes	Yes	BCM957412M4123C
OCP 2.0	M125p	1x 25/10GbE	SFP28	BCM57412	Wh+	Yes	Yes	BCM957412M4122C
OCP 2.0	M225P	2x 25/10GbE	SFP28	BCM57414	Wh+	Yes	Yes	BCM957414M4142C
OCP 2.0	M150P	1 x 50GbE	QSFP28	BCM57414	Wh+	Yes	Yes	BCM957414M4143C
OCP 2.0	M1100G16 (1x16)	1x 100G	QSFP28	BCM57504	Thor	Yes	Yes	BCM957504-M1100G16

Broadest Portfolio of OCP 2.0 Adapters

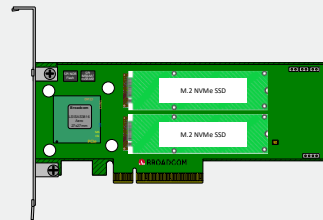
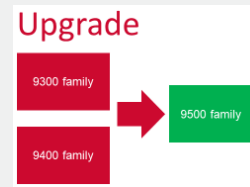
Broadcom Storage Strategy



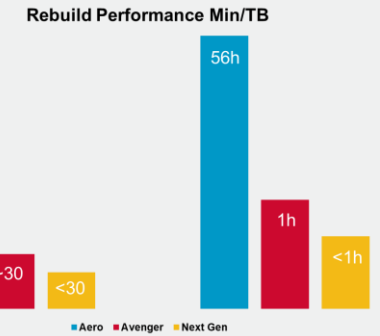
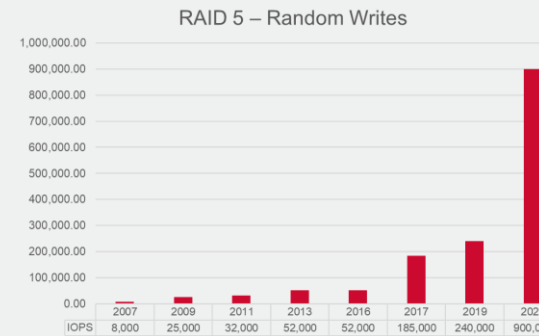
Storage Broadcom Strategy

Server Storage Hot Topics 2022/23

- Generational transition
- OCP Storage Adapters
- NVMe boot adapter



Return to Relevance



- Key Downsides of RAID identified & addressed
- Major performance improvements upcoming
- HW NVMe RAID to be a great story

Thank You





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connecting everything®

Backup Slides

